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# "STUDIES ON EFFECT OF PRE-TREATMENTS AND DRYING METHODS ON QUALITY OF DRIED POMEGRANATE ARILS"

**MADHUSHREE. M, BHUVANESHWARI, G. JAGADEESH & S. L. V. M. GANIGER**

*Department of Post Harvest Technology, College of Horticulture, Bagalkot, Karnataka, India &*

*University of Horticultural Sciences, Udyanagiri, Bagalkot, Karnataka, India*

***ABSTRACT***

***Studies undertaken to prepare dried pomegranate arils and its quality evaluation are reported here. Pomegranate arils were treated with different pre-treatments (Osmotic treatment, freezing, freezing + osmotic treatment and control) and then dried in sun, solar tunnel and tray drier. Among different pre-treatments osmotic treatment was adjudged to be the best on the basis of its bio-chemical (Yield: 232.54 g/kg, Non-enzymatic browning: 0.21, water loss: 32.28%, solute gain: 3.44 %) and sensory characteristics. Arils dried in tray drier resulted in better quality of dried arils (Drying time 22.13 h, moisture 8.43 %, TSS: 53.97° B, Non-enzymatic browning: 0.21). Osmotic pre-treatment and tray drying was found best for drying of pomegranate arils.***

***KEYWORDS: Pomegranate Arils, Solar Tunnel Drying, Tray Drier and Aluminium Laminated Pouch***

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**Original Article**

## INTRODUCTION

Pomegranate (*Punica granatum)* belonging to the family Punicaceae is an ancient favourite table-fruit of the tropical and sub-tropical regions of the world. The word pomegranate is derived from pomum (fruit) and granates (seeded). Locally pomegranate is known as *Dhalimbe*. Morphologically it is known as Balusta. Pomegranate is native to Iran and is widely cultivated throughout India. As a commercial crop, pomegranate is grown on a large scale in Maharashtra, Karnataka, Andhra Pradesh, Uttar Pradesh, Gujarat, Rajasthan and Tamil Nadu. In the world it is also grown in Burma, China, Japan and USA (Redge and Pai, 1999).

There are several techniques of preservation or processing available for different fruits. Dehydration of perishables like fruits and vegetables are best suited under Indian conditions (Jayraman and Dasagupta, 1992; Jayraman and Dasagupta, 1995 and Dasagupta, 2005). Among the different methods of food preservation, convective dehydration is the most popular and efficient way to reduce the moisture content and preserve foods. Product quality notably depends on texture, colour and flavour and they deteriorate with convective dehydration (Lenart, 1996). A well known process to achieve good quality product is freeze drying, but this is an expensive method of food preservation. Therefore, there is a need for simple economic and technically feasible alternative drying processes with low capital cost and offer a method to save highly perishable products and making them available to the regions away from production zone. Among the drying process, osmotic dehydration is one such method of food preservation (Shi and Le-Maguer, 2002). It is a paradox that such a miracle fruit having enormous potential for therapeutic use has never been utilized for value addition except in the form of beverages. The objective of this research was to study the effect of different pre-treatments and drying methods on quality of

dehydrated arils.

## MATERIAL AND METHODS

### Raw Materials

Fresh pomegranate fruits (var. Kesar) used in research was purchased from Kaladagi, a place known for production of pomegranate.

### Separation of Arils

Pomegranate fruits harvested at optimum maturity were brought to the Department of Post Harvest Technology, Bagalkot. Fruits after thorough washing in tap water were cut into four to six parts by clean stainless steel knife and then arils were separated manually.

### Freezing of Pomegranate Fruits

Fresh and well graded, whole pomegranate fruits were washed and frozen at temperature of -18ºC for 4 hours duration.

### Syrup Preparation

Sugar syrup of 50 º brix concentrations was prepared by mixing 1 kg of sugar and 1 kg of water.

### Osmotic Treatment

Pomegranate arils were dipped in 50º brix osmotic solution concentration of 40ºC temperature in the ratio of 1:2 (w/w) arils to syrup and allowed to stand for 100 min. At the end of the treatment, arils were taken out from the osmotic solution and weighed to know the extent of water removal from the arils by osmosis.

### Drying

Pre-treated arils were dried by various drying methods at varying temperature upto get a constant weight. The time required for drying of the product to optimum moisture was recorded in different treatments.

**Open Sun Drying:** The pre-treated arils were spread on the aluminium trays and kept in the open space facing the sun in an inclined position for drying were dried under Sun till they attained a constant weight.

**Solar Tunnel Drying:** Arils were placed on the clean aluminium trays and kept for drying in solar tunnel drier until they attained a constant weight.

**Tray Drying:** Known weight of pre-treated arils were spread thinly on stainless steel trays and kept in cabinet tray drier for dehydration. Arils were thoroughly air dried at 60ºC temperature till the arils reached desired moisture content and product quality.

### Treatment Details

### Factor I: Pre-Treatments - 4

**$T_1$:** Osmotic treatment

**$T_2$:** Freezing

**$T_3$:** Freezing + Osmotic treatment

**$T_4$:** Control (Without freezing + without osmotic treatment)

**Factor II: Type of drying - 3**

**$D_1$:** Sun drying

**$D_2$:** Solar tunnel drying

**$D_3$:** Tray drying

**Design of the Experiment**: Factorial completely randomized design

**Replications**: 3

### Physico-Chemical Characteristics of Arils

The dried arils were analyzed for various physicochemical characteristics as per standard methods of analysis. Visual colour of dried arils was recorded by visual observation and expressed as red, purple, brownish red and brown. The time required for drying of the pomegranate arils to get a constant weight was recorded and expressed in hours. The water loss and solute gain during osmotic dehydration were calculated by the equations given by Ozen *et al.* (2002) and Singh *et al.* (2007), respectively. Yield of dried arils from one kg of fresh pomegranate arils was calculated on weight basis and expressed in grams. Moisture content in the dried pomegranate arils was analyzed using ‘Radwag’ moisture meter (Model: MAC 50). The total soluble solids of dried pomegranate arils was calculated as per Anon. (2005). Nonenzymic browning (NEB) was estimated as per Srivastava and Sanjeevkumar (1998). Colour of the samples was measured using Lovibond colour meter (Model: Lovibond RT300, Portable Spectrometer, The Tintometer Limited, Salisbury, UK) fitted with 8 mm diameter aperture. Colour was expressed in Lovibond units $L*$ (lightness/darkness), $a*$ (redness/greeness), $b*$ (yellowness/blueness). Dried arils were evaluated for sensory quality by 15 semi trained panel consisting of Teachers and Post-Graduate students of College of Horticulture, Bagalkot with the help of nine point hedonic rating scale.

## RESULTS AND DISCUSSIONS

### Drying Time and Yield of Arils

The mean drying time of the pre-treatments irrespective of drying method varied between 33.67 h and 35.78 h (Table 1). Shortest drying time (33.67 h) was observed in the pre-treatment $T_3$ (Freezing + Osmotic treatment). This might be due to freezing as a pre-treatment prior to osmotic dehydration process, which modified the cell structure of arils there by enhanced the water loss during the osmotic process, hence the lower moisture content of arils leads to shortest drying time of arils. Similar findings were also reported by Bchir *et al*. (2011) in pomegranate arils, Falade and Adelakun (2007) in apple and Kowalska *et al*. (2008) in pumpkin. This might also be due to leaching of some soluble components of cellular structure of arils losen the surface cellular structure during soaking in osmotic solution. This reduces cell wall resistance and increases the drying rate of arils, in turn decreases the drying duration. The results are in conformity with the results of Riva *et al*. (2004) for apricot cubes, Rodrigues and Fernandes (2007) for melons. The shortest drying time (22.13 h) was observed in the drying method $D_3$ (Tray drier) which may be attributed to the continuous controlled temperature and air movement reduced drying time as compared to the low and fluctuating temperature in solar tunnel drier and sun drying. The results obtained for drying time are in conformity with the findings of various workers (Desrosier and Desrosier, 1982; Chandel *et. al.* 1989; Pruthi and Saxena, 1984).

The mean yield of dried pomegranate arils of the pre-treatments irrespective of drying method varied between 203.80 g/kg and 232.54 g/kg (Table 1). The highest yield (232.54 g/kg) was recorded in the pre-treatment $T_1$ (Osmotic treatment) followed by $T_3$ (Freezing + Osmotic treatment), while the lowest yield was recorded in $T_2$ (Freezing). It has been reported that due to increase in the solid gain and the volume reduction of the osmo-dehydrated product increases the drier load and process yield (Torreggiani, 1993 and Thippanna, 2005).

**Moisture and Total Soluble Solids**

Significant difference was found to exist in the mean moisture content of pre-treatments. Irrespective of the drying methods, the mean moisture content of the pre-treatments ranged from 8.90 to 10.41 per cent (Table 8). The lowest moisture content (8.90%) was recorded in $T_3$ (Freezing + Osmotic treatment) followed by $T_1$ (Osmotic treatment). The lowest moisture content in these treatments was due to moisture removal and solute gain during osmotic dehydration.

Present study reveals that, the mean total soluble solids content of the dried pomegranate arils of different pre-treatments irrespective of drying methods varied between 27.99 and 64.29º brix and significantly highest TSS content was recorded in $T_3$ (Freezing + Osmotic treatment; 64.29º brix) and it was lowest in $T_4$ [Control (Without freezing + Without osmotic treatment)] (Table 2). This might be due to freezing before osmotic dehydration of pomegranate arils proved to increase solid gain in comparison with samples without pre-treatment due to cellular structure disruption of arils as a result of the freeze-thaw ice water transformation and thus favour high solute uptake. These results were well supported by Bchir *et al*. (2011) in pomegranate arils and Kowalska *et al*. (2008) in pumpkin.

Arils dried in tray drier resulted in lowest moisture (8.43 %) and highest total soluble solids (53.97º brix). The results obtained are in conformity with the findings of various workers (Desrosier and Desrosier, 1982; Chandel, *et. al.*, 1989; Pruthi and Saxena, 1984).

**Non Enzymatic Browning**

The mean score of non enzymatic browning irrespective of drying methods varied between 0.21 and 0.36 (Table 3). Significantly, the highest value (0.36) for non enzymatic browning was recorded in pre-treatment $T_4$ [Control (Without freezing + without osmotic treatment)] (Table 4). Lowest value (0.21) was recorded in $T_1$ (Osmotic treatment), which might be due to the reason as arils are covered with sugar solution there was no tissue exposure to oxygen which results in reduced browning (Dixon *et al*., 1976). Minimum score (0.21) for non enzymatic browning was recorded in $D_3$ (Tray drier) which may be attributed to the formation of NEB products at a reduced rate therefore, prevented brown pigment formation in the dried arils. Similar trend of results have been reported by Bhat *et al*. (2014) in wild pomegranate arils; Mahajan *et al*. (1992) in wild pomegranate and Bhardwaj and Lal (1990) in apple rings.

**Colour ($L^*$ $a^*$ $b^*$) and Visual Colour of Aril**

The maximum colour $L^*$ value (26.59) was recorded in $T_4$ [Control (Without freezing + without osmotic treatment)] and the minimum colour $L^*$ value (20.83) was recorded in $T_3$ (Freezing + Osmotic treatment) indicating the darker colour of the product. As pomegranate arils covered with sucrose syrup, reduced darkening of arils during drying. This is supported by the higher $a^*$ value (12.92) recorded in the treatment $T_3$ (Freezing + Osmotic treatment) which was closely followed by $T_1$ (12.28) (Osmotic treatment) showing that the samples with osmotic treatment were more red in colour, while the minimum $a^*$ value (9.72) was recorded in $T_4$ [Control (Without Freezing + Without osmotic treatment)]. Among the drying methods highest $L^*$ value (26.72) was recorded in $D_1$ (Sun drying) followed by solar tunnel drier

(23.18) could be due to fluctuating temperature in solar tunnel drier and sun drying (Table 4).

Attractive reddish purple coloured arils were obtained in $T_1D_3$ (Osmotic treatment and tray drying) and $T_3D_3$ (Freezing + Osmotic treatment and tray drying) resulted in purple colour. The treatments $T_2D_3$ (Freezing and tray drying) and $T_4D_3$ [Control (Without Freezing + Without osmotic treatment) and tray drying] resulted in dark purple colour (Table 5).

**Water Loss and Solute Gain**

Significant difference was found to exist in the mean water loss and solute gain of the treatments (Osmotic and Freezing + Osmotic treatment). Maximum mean score (37.71%) for water loss was recorded in the freezing + osmotic treatment of arils. Minimum value (32.28%) was recorded in the osmotic treatment (Table 6). Significantly, highest solute gain (4.61%) was recorded in the freezing + osmotic treatment. Lowest (3.44%) was recorded in the osmotic treatment. Freezing prior to osmotic dehydration has been reported to enhance the mass transfer during osmotic dehydration (Falade and Adelakun, 2007; Kowalska *et al*., 2008). This might be due to freezing before osmotic dehydration of pomegranate arils proved to increase the solid gain in comparison with samples without this pre-treatment due to cellular structure disruption of arils as a result of the freeze-thaw ice water transformation and thus favouring high solute uptake. Similar trend of results have also been reported by Bchir *et al*. (2011) in pomegranate arils; Falade and Adelakun (2007) in apple and Kowalska *et al*. (2008) in pumpkin.

**Sensory Evaluation**

The evaluation of dried pomegranate arils was done on the basis of colour, taste, aroma, texture and overall acceptability (Table 7, 8 and 9). The scores for all sensory characters of dried pomegranate arils were varied significantly for pre-treatments and drying methods.

Irrespective of the drying methods, the mean colour score of the pre-treatments ranged between 6.09 and 6.75. Significantly maximum mean score for colour (6.75) was recorded in $T_1$ (Osmotic treatment), which was closely followed by $T_3$ (6.65) (Freezing + Osmotic treatment) and $T_2$ (6.33) (Freezing). The minimum mean score (6.09) was recorded in $T_4$ [Control (Without Freezing + Without osmotic treatment)].

The mean flavour score of the treatments for dried pomegranate arils irrespective of the drying methods, ranged between 5.89 and 6.84. Significantly maximum mean score (6.84) for flavour was recorded in $T_1$ (Osmotic treatment), which was closely followed by $T_3$ (6.59) (Freezing + Osmotic treatment). The minimum mean score (5.89) was recorded in $T_4$ [Control (Without Freezing + Without osmotic treatment)] followed by $T_2$ (5.92) (Freezing).

Irrespective of the drying methods, the mean taste score of the treatments ranged between 5.89 and 6.96. Significantly maximum mean score for taste (6.96) was recorded in $T_1$ (Osmotic treatment) and it was found statistically similar with $T_3$ (6.73) (Freezing + Osmotic treatment). The minimum mean score (5.89) was recorded in $T_4$ [Control (Without Freezing + Without osmotic treatment)].

The mean texture score of the dried pomegranate arils with treatments irrespective of the drying methods, ranged between 6.14 and 6.83. Significantly maximum mean score (6.83) for texture was recorded in $T_1$ (Osmotic treatment) and it was found statistically similar with $T_3$ (6.82) (Freezing + Osmotic treatment). The minimum mean score was recorded in $T_4$ (6.14) [Control (Without Freezing + Without osmotic treatment)].

The mean overall acceptability score of the treatments irrespective of drying methods varied between 5.93 and 6.91. The highest score (6.91) was registered in the pre-treatment $T_1$ (Osmotic treatment) which was closely followed by $T_3$ (6.71) (Freezing + Osmotic treatment). Significantly lowest score was recorded in $T_4$ (5.93) [Control (Without Freezing + Without osmotic treatment)].

The reason for higher colour and flavour retention in osmotically treated arils was due to mild heat treatment during osmotic treatment favours colour and flavour retention resulting in the product having superior organoleptic characteristics thus increases resistance to heat treatment and also constant immersion of product in sucrose solution avoids the oxygen exposure of the product thus it retains better colour (Chavan, 2012). Osmotic treatment protects against the structural collapse of arils during subsequent drying thus helping to retain the shape and texture of the dehydrated arils (Chavan, 2012) and also high texture of osmotically pre-treated arils might be due to low moisture content in the arils (Bhat *et al*., 2014). The variation in overall acceptability of treatments may be due to variability of colour, flavour, texture and taste of the pre-treated pomegranate dried arils.

Among the drying methods, highest score for colour (7.31), flavour (6.69), taste (6.72), texture (6.83) and overall acceptability (7.06) were recorded in $D_3$ (Tray drying). This might be due to continuous controlled temperature and air movement in tray drier (Bhat *et al*., 2014).

## CONCLUSIONS

From the experiment it can be concluded that among different pre-treatments and drying methods, osmotic treatment and tray drying was found to be better with respect to some physic-chemical and sensory quality of dried pomegranate arils.

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## APPENDICES

**Table 1: Effect of Pre-Treatments and Drying Methods on Drying Time and Yield of Pomegranate Arils**

| Pre-Treatments | | | Drying Time (h) | | | | Yield of Arils (g/kg) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $D_1$ | $D_2$ | $D_3$ | Mean | $D_1$ | $D_2$ | $D_3$ | Mean |
| $T_1$ | - | Osmotic treatment | 47.00 | 33.83 | 21.67 | **34.17** | 230.63 | 233.37 | 233.63 | **232.54** |

**Table 1: Contd.,**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $T_2$ | - | Freezing | 47.67 | 34.33 | 22.50 | **34.83** | 201.03 | 207.30 | 203.07 | **203.80** |
| $T_3$ | - | Freezing + Osmotic treatment | 46.33 | 33.50 | 21.17 | **33.67** | 224.90 | 229.90 | 231.83 | **228.88** |
| $T_4$ | - | Control (Without freezing + Without osmotic treatment) | 48.33 | 35.83 | 22.13 | **35.78** | 205.00 | 209.30 | 207.43 | **207.24** |
| **Mean** | | | **47.33** | **34.38** | **22.13** | | **215.39** | **219.97** | **218.99** | |
| | | | **SEm±** | | **CD (1%)** | | **SEm±** | | **CD (1%)** | |
| **Pre-treatments** | | | 0.34 | | 1.36 | | 1.37 | | 5.47 | |
| **Drying** | | | 0.30 | | 1.18 | | 1.19 | | NS | |
| **Interaction (TxD)** | | | 0.59 | | NS | | 2.38 | | NS | |

$D_1$=Sun drying $D_2$=Solar tunnel drying $D_3$=Tray drying NS=Non significant

**Table 2: Changes in Moisture and Total Soluble Solids of Dried Pomegranate Arils as Influenced by Pre Treatments and Drying Method**

| **Pre-Treatments** | | | **Moisture (%)** | | | | **Total Soluble Solids (Brix)** | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | **$D_1$** | **$D_2$** | **$D_3$** | **Mean** | **$D_1$** | **$D_2$** | **$D_3$** | **Mean** |
| $T_1$ | - | Osmotic treatment | 10.89 | 8.83 | 8.18 | **9.30** | 63.60 | 64.55 | 63.78 | **63.98** |
| $T_2$ | - | Freezing | 11.26 | 9.09 | 8.34 | **9.56** | 45.78 | 37.05 | 52.23 | **45.02** |
| $T_3$ | - | Freezing + Osmotic treatment | 10.43 | 8.48 | 7.80 | **8.90** | 64.36 | 63.88 | 64.64 | **64.29** |
| $T_4$ | - | Control (Without freezing + Without osmotic treatment) | 12.01 | 9.83 | 9.37 | **10.41** | 28.76 | 19.98 | 35.24 | **27.99** |
| **Mean** | | | **11.15** | **9.06** | **8.43** | | **50.63** | **46.36** | **53.97** | |
| | | | **SEm±** | | **CD (1%)** | | **SEm±** | | **CD (1%)** | |
| **Pre-treatments** | | | 0.29 | | 1.15 | | 1.05 | | 4.20 | |
| **Drying** | | | 0.25 | | 0.99 | | 0.91 | | 3.64 | |
| **Interaction (TxD)** | | | 0.50 | | NS | | 1.83 | | 7.28 | |

$D_1$=Sun drying $D_2$=Solar tunnel drying $D_3$=Tray drying NS=Non significant

**Table 3: Effect of Pre-Treatments and Drying Methods on Non Enzymatic Browning of Dried Pomegranate Arils**

| **Pre-Treatments** | | | **Non Enzymatic Browning** | | | |
|---|---|---|---|---|---|---|
| | | | **$D_1$** | **$D_2$** | **$D_3$** | **Mean** |
| $T_1$ | - | Osmotic treatment | 0.32 | 0.17 | 0.15 | **0.21** |
| $T_2$ | - | Freezing | 0.37 | 0.37 | 0.26 | **0.33** |
| $T_3$ | - | Freezing + Osmotic treatment | 0.25 | 0.26 | 0.20 | **0.24** |
| $T_4$ | - | Control (Without freezing + Without osmotic treatment) | 0.51 | 0.32 | 0.24 | **0.36** |
| **Mean** | | | **0.36** | **0.28** | **0.21** | |
| | | | **SEm±** | | **CD (1%)** | |
| **Pre-treatments** | | | 0.01 | | 0.06 | |
| **Drying** | | | 0.01 | | 0.05 | |
| **Interaction (TxD)** | | | 0.02 | | 0.10 | |

$D_1$=Sun drying $D_2$=Solar tunnel drying $D_3$=Tray drying

**Table 4: Effect of Pre-Treatments and Drying Methods on Colour (*L* a* b**) of Dried Pomegranate Arils**

| **Pre-Treatments** | | | ***L**** | | | | ***a**** | | | | ***b**** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **$D_1$** | **$D_2$** | **$D_3$** | **Mean** | **$D_1$** | **$D_2$** | **$D_3$** | **Mean** | **$D_1$** | **$D_2$** | **$D_3$** | **Mean** |
| $T_1$ | - | Osmotic treatment | 25.76 | 22.58 | 19.10 | **22.48** | 9.67 | 12.51 | 14.66 | **12.28** | 9.65 | 13.07 | 4.01 | **8.91** |
| $T_2$ | - | Freezing | 27.20 | 23.53 | 20.76 | **23.83** | 9.18 | 10.66 | 12.84 | **10.89** | 7.23 | 6.65 | 4.17 | **6.02** |
| $T_3$ | - | Freezing + Osmotic treatment | 23.02 | 21.06 | 18.41 | **20.83** | 12.37 | 12.56 | 13.82 | **12.92** | 7.74 | 4.67 | 3.69 | **5.37** |
| $T_4$ | - | Control | 30.90 | 25.55 | 23.32 | **26.59** | 8.48 | 8.78 | 11.91 | **9.72** | 14.91 | 6.06 | 3.90 | **8.29** |
| **Mean** | | | **26.72** | **23.18** | **20.40** | | **9.92** | **11.13** | **13.31** | | **9.88** | **7.61** | **3.94** | |

| Table 4: Contd., | | | | | | |
|---|---|---|---|---|---|---|
| | **SEm±** | **CD (1%)** | **SEm±** | **CD (1%)** | **SEm±** | **CD (1%)** |
| **Pre-treatments** | 1.97 | NS | 1.38 | NS | 1.68 | NS |
| **Drying** | 1.70 | NS | 1.19 | NS | 1.45 | NS |
| **Interaction (TxD)** | 3.41 | NS | 2.38 | NS | 2.91 | NS |

$D_1$=Sun drying $D_2$=Solar tunnel drying $D_3$=Tray drying NS=Non significant

**Table 5: Effect of Pre-Treatments and Drying Methods on Visual Colour of Dried Pomegranate Arils**

| Pre-treatments | | | Visual colour | | |
|---|---|---|---|---|---|
| | | | **$D_1$** | **$D_2$** | **$D_3$** |
| $T_1$ | - | Osmotic treatment | Brown | Brownish Red | Reddish Purple |
| $T_2$ | - | Freezing | Dark Brown | Brownish Red | Dark Purple |
| $T_3$ | - | Freezing + Osmotic treatment | Brown | Brownish Red | Purple |
| $T_4$ | - | Control (Without freezing + Without osmotic treatment) | Dark Brown | Brownish Red | Dark Purple |

$D_1$=Sun drying $D_2$=Solar tunnel drying $D_3$=Tray drying

**Table 6: Effect of Pre-Treatments on Waterloss and Solute Gain of Pomegranate Arils**

| Pre-Treatments | | | Water Loss (%) | Solute Gain (%) |
|---|---|---|---|---|
| $T_1$ | - | Osmotic treatment | 32.28 | 3.44 |
| $T_3$ | - | Freezing + Osmotic treatment | 37.71 | 4.61 |
| **SEm±** | | | **0.63** | **0.10** |
| **CD (1%)** | | | **2.48** | **0.38** |

**Table 7: Effect of Pre-Treatments and Drying Methods on Colour and Flavour of Dried Pomegranate Arils**

| Pre-Treatments | | | Colour * | | | | Flavour * | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | **$D_1$** | **$D_2$** | **$D_3$** | **Mean** | **$D_1$** | **$D_2$** | **$D_3$** | **Mean** |
| $T_1$ | - | Osmotic treatment | 6.10 | 6.90 | 7.25 | **6.75** | 6.29 | 6.71 | 7.54 | **6.84** |
| $T_2$ | - | Freezing | 5.40 | 6.10 | 7.50 | **6.33** | 5.71 | 6.18 | 5.85 | **5.92** |
| $T_3$ | - | Freezing + Osmotic treatment | 5.79 | 6.43 | 7.71 | **6.65** | 6.18 | 6.40 | 7.21 | **6.59** |
| $T_4$ | - | Control | 5.07 | 6.46 | 6.75 | **6.09** | 5.29 | 6.21 | 6.15 | **5.89** |
| **Mean** | | | **5.58** | **6.47** | **7.31** | | **5.86** | **6.38** | **6.69** | |
| | | | **SEm±** | | **CD (1%)** | | **SEm±** | | **CD (1%)** | |
| **Pre-treatments** | | | 0.16 | | 0.58 | | 0.16 | | 0.59 | |
| **Drying** | | | 0.14 | | 0.50 | | 0.14 | | 0.51 | |
| **Interaction (TxD)** | | | 0.29 | | 0.99 | | 0.30 | | 1.02 | |

$D_1$=Sun drying $D_2$=Solar tunnel drying $D_3$=Tray drying

* Score out of 9

**Table 8: Effect of Pre-Treatments and Drying Methods on Taste and Texture of Dried Pomegranate Arils**

| Pre-Treatments | | | Taste * | | | | Texture * | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | **$D_1$** | **$D_2$** | **$D_3$** | **Mean** | **$D_1$** | **$D_2$** | **$D_3$** | **Mean** |
| $T_1$ | - | Osmotic treatment | 6.50 | 6.79 | 7.60 | **6.96** | 6.10 | 6.82 | 7.56 | **6.83** |
| $T_2$ | - | Freezing | 5.85 | 6.18 | 5.79 | **5.94** | 5.90 | 6.25 | 6.32 | **6.16** |
| $T_3$ | - | Freezing + Osmotic treatment | 6.46 | 6.40 | 7.35 | **6.73** | 6.75 | 6.54 | 7.18 | **6.82** |
| $T_4$ | - | Control | 5.21 | 6.29 | 6.15 | **5.89** | 5.68 | 6.46 | 6.25 | **6.14** |
| **Mean** | | | **6.01** | **6.42** | **6.72** | | **6.10** | **6.52** | **6.83** | |
| | | | **SEm±** | | **CD (1%)** | | **SEm±** | | **CD (1%)** | |
| **Pre-treatments** | | | 0.17 | | 0.63 | | 0.17 | | 0.63 | |
| **Drying** | | | 0.15 | | 0.55 | | 0.14 | | 0.55 | |
| **Interaction (TxD)** | | | 0.32 | | 1.09 | | 0.30 | | 1.08 | |

$D_1$=Sun drying $D_2$=Solar tunnel drying $D_3$=Tray drying

* Score out of 9

**Table 9: Effect of Pre-Treatments and Drying Methods on Overall Acceptability of Dried Pomegranate Arils**

| Pre-Treatments | | | Overall Acceptability * | | | |
|---|---|---|---|---|---|---|
| | | | $D_1$ | $D_2$ | $D_3$ | Mean |
| $T_1$ | - | Osmotic treatment | 5.96 | 6.82 | 7.93 | **6.91** |
| $T_2$ | - | Freezing | 5.57 | 6.43 | 6.65 | **6.21** |
| $T_3$ | - | Freezing + Osmotic treatment | 6.40 | 6.46 | 7.29 | **6.71** |
| $T_4$ | - | Control | 5.43 | 6.00 | 6.35 | **5.93** |
| **Mean** | | | **5.83** | **6.43** | **7.06** | |
| | | | **SEm±** | | **CD (1%)** | |
| **Pre-treatments** | | | 0.16 | | 0.58 | |
| **Drying** | | | 0.14 | | 0.49 | |
| **Interaction (TxD)** | | | 0.29 | | 1.00 | |

$D_1$=Sun drying $D_2$=Solar tunnel drying $D_3$=Tray drying

* Score out of 9